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Docket No. 95-18A2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

ON APPEAL TO THE BOARD OF APPEALS

In re: Application of:

Thelma G. Manning,
Joseph L. Prezelski,
Sam Moy,
Bernard Strauss,
James Hartwell,
Arpad A. Juhasz,
and
Robert J. Lieb

Examiner: Edward A. Miller

Serial No.: 09/665,190

Group Art Unit: 3641

Filed: September 12, 2000

For: HIGH ENERGY THERMOPLASTIC ELASTOMER PROPELLANT

APPELLANT'S BRIEF ON APPEAL

Commissioner for Patents,
PO Box 1450,
Alexandria, Virginia 22313-1450

Dear Sir:

This paper is submitted in compliance with 37 C.F.R. § 41.37, and is a Brief on behalf of the Appellant in the above-captioned appeal from the final rejection of claims . No claims have been allowed in the present application.

ORAL HEARING

An oral hearing on the issues in this appeal is requested.

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37 C.F.R § 41.37(c) Page No.

37 C.F.R. § 41.37(c)(i) Real Party In Interest

The real party in interest in this Application is the United States of America. The present application is assigned of record to the United States of America, as represented by the Secretary of the Army.

37 C.F.R. § 41.37(c)(ii) Related Appeals and Interferences

None

37 C.F.R. § 41.37(c)(iii) Status of Claims

The claims are 6 to 15. Claims 6 to 12, 14, and 15 stand withdrawn from consideration pursuant to a Restriction Requirement traversed by Applicants. Claim 13 stands FINALLY rejected. Although both 35 U.S.C. § 102 and 35 U.S.C. § 103(a) are quoted in the most recent Office Action, the Claim appears to be rejected only under 35 U.S.C. § 103(a) as being unpatentable over United States Patent 5,690,868 to Strauss, Manning, Prezelski, and Moy, in view of United States Patent 5,798,481 to Manning, Strauss, Prezelski, and Moy, United States Patent 5,716,557 to Strauss, Manning, Prezelski, and Moy, United States Patent 5,759,458 to Haaland, Braithwaite, Hartwell, Lott, and Rose, and United States Patent 6,171,530 to Haaland, Braithwaite, Hartwell, Lott, and Rose.

37 C.F.R. § 41.37(c)(iv) Status of Amendments

There are no unentered amendments.

37 C.F.R. § 41.37(c)(v) Summary of the Claimed Invention

(a) Summary

The only claim presented in this appeal relates to a process for preparation of a propellant composition material. That material comprises a combination of two high energy propellants, each comprising an oxetane thermoplastic elastomer energetic binder admixed with a high energy explosive filler. The oxetane thermoplastic elastomer energetic binder preferably comprises from about five percent to about thirty percent by weight and the high energy explosive filler comprises from about seventy percent to

about ninety-five percent by weight of the composition. The preferred propellant further includes an explosive plasticizer, preferably in an amount of from about four percent to about seven percent of the plasticizer by weight of the propellant. The preferred filler is selected from the group consisting of CL-20, TNAZ, RDX, and mixtures thereof. The preferred plasticizer is selected from the group consisting of TNAZ, BTTN, TMETN, TEGDN, BDNPA/F, methyl NANA, ethyl NENA, and mixtures thereof. In the appealed claim, the propellant is actually a pair of high energy propellants comprising a mixture of first and second high energy propellants with the first propellant having a burn rate at least two times faster than the burn rate of the second propellant. The first propellant includes an oxetane thermoplastic elastomer energetic binder admixed with CL-20 high energy explosive filler. The second propellant including an oxetane thermoplastic energetic binder admixed with RDX high energy explosive filler. Plasticizers and relative amounts for each of the first and second propellants are the same as for the single propellant. The propellants are prepared separately, admixed and extruded in a desired form.

Details of the process, and references to the specification, are set out at length in the Argument which follows.

(b) Background

As with the evolution of many technologies, new weapon systems require higher munitions performance. Current standard propellants do not have adequate energy to deliver the performance required for systems that are presently being developed. JA2,

which is a standard double base propellant used, for example, in the M829A1 and M829A2 tank rounds, has an impetus value of 1150 Joules/gram (or J/g). M43, which is used in the M900A1 cartridge, has an impetus of 1181 J/g. Both of these conventional propellants do not have the energy level to deliver the muzzle velocity required in future high energy tank systems, such as the M829E3. Theoretical calculations have shown that a propellant containing an energy above the 1300 J/g threshold is needed.

In addition to the energy content, it has been shown by theoretical calculations that the ballistic cycle can be optimized and work output can be maximized by using a combination of two equienergetic propellants whose burning rates are different by a factor of three or four. The slow burning propellant is designed to enter the cycle at a later time Current standard propellants do not exhibit such wide variation in burning rates at a specified energy level. Standard tank gun propellants such as XM39, M43, M44, or JA2 have burning rate differentials that are, at best, less than two to one, and thus they are unsatisfactory for solving the problem of delivering much higher muzzle velocities

In addition to the inability to generate adequate energy levels, present day propellants produce volatile organic compounds and ancillary waste, especially in enhanced demil and recyclability.

Accordingly, one object of the present invention is to provide a pair of high energy propellants whose average impetus is at or above the 1300 J/g level.

Another object of this invention is to provide a pair of high energy propellants whose burning rate differential is three or greater.

An additional object of this invention is to provide new energetic materials and processes that eliminate or greatly reduce both volatile organic compound production and ancillary waste through demil and recyclability.

(c) The Invention

The present invention has many advantages over the prior art propellant formulations. In its simplest form, the invention comprises an oxetane thermoplastic elastomer energetic binder admixed with a high energy explosive filler. A plasticizer may be added in some applications.

The oxetane thermoplastic elastomer energetic binder is an essential part of the invention and is available from Thiokol Corporation. It is capable of being melted at elevated temperatures to allow the binder to be processable with other propellant ingredients without the use of solvents, and this is a major advantage. In addition, as will be shown below, the oxetane thermoplastic energetic binder has excellent mechanical properties that are superior to conventional propellants because of elastomeric characteristics, especially at cold temperatures such as -20° to -40° F. This binder also has good mechanical properties that are important for uniform ballistic perfprmance as well as having low vulnerability to shaped charge jet impact.

In order to verify the excellent properties of the oxetane thermoplastic elastomer energetic binder, thermal stability tests were performed. Results of these tests are shown in Table I below.

TABLE I

Sample	Self Heat, °C	Ignition, °C
OXETANE Only	166	229
OXETANE/TNAZ (1:1)	153	216
OXETANE/CL-20 (1:1)	181	206
OXETANE/RDX (1:1)	196	222

In order to demonstrate the effectiveness of the propellants of this invention, a number of gun propellant formulations were mixed and extruded. The method of preparing the formulations comprised the steps of mixing at about 95°C and extruding at slightly lower temperatures. Processing at these temperatures provided a safe operating margin of at least 50°C because the self heat temperatures of the filler ranges from about 175°C to 192°C, but the preferred plasticizer TNAZ melts around 100°C, so that as some of the TNAZ begins to melt during processing at 95°C, a more fluid mix results that is easier to process. Presented below in Table II are seven formulations that have been prepared. All values for the composition are given in percent by weight, based on the total weight.

TABLE II

Sample	Oxetane	Filler/amount	Impetus, J/g	Flame, °K
A	24	CL-20/76	1297	3412
B	24	TNAZ/76	1309	3321
C	20	TNAZ/76*	1335	3475
D	20	CL-20/76*	1324	3575
E	13.3	RDX/80**	1319	3395
F	18	RDX/76***	1306	1348
G	20	CL-20****	1348	3683

* Sample also included 4% BDNPA/F as plasticizer
** Sample also included 6.7% BDNPA/F as plasticizer
*** Sample also included 6% TNAZ as plasticizer
**** Sample also included 4% TNAZ as plasticizer

Each of the above batches was formulated into a propellant by mixing and then extruding at a lower temperature. Selection and control of the precise extrusion parameters was important to obtain proper grain dimensions without excessive swelling of deformation. Table III below identifies the barrel temperature, die temperature and ram speed for each sample batch.

TABLE III

Sample	Barrel temp.,°C	Die temp.,°C	Ram speed, in/min.
A	82	70	0.14
B	95	86	0.14
C	89	82	0.06
D	87	78	0.03
E	100	91	0.14
F	100	85	0.08
G	66	55	0.04

Each of these formulations were tested for various properties to demonstrate the efficacy of the present invention: specifically, impact, differential thermal analysis

(DTA), and electrostatic and friction sensitivity characteristics. Presented below in Table IV are the results of these tests. The results show that impact sensitivities are similar to the conventional propellant M43, and that the products of this invention are quite thermally stable. A negative annotation for electrostatic sensitivity indicates no reaction to a 12 Joule electrostatic charge while a negative friction value is for a test with a 60 pound weight. The last two samples were not fully tested and n/a indicates that no data is available.

TABLE V

Sample	Impact (cm)	DTE, Self heat (°C)	DTA, Ignition (°C)	Electrostatic (12 Joules)	Friction (Bole)
A	50	179	203	neg	neg
B	40	175	211	neg	neg
C	20	175	212	neg	neg
D	40	174	206	neg	neg
E	40	206	225	neg	neg
F	n/a	n/a	n/a	neg	neg
G	n/a	n/a	n/a	neg	neg

The next evaluation of these samples was to determine the burn rate at various conditions. The data for the burn rates, presented below in Table VI, represent closed bomb data. As can be seen, RDX containing samples E and F have the slowest burning rates, which is comparable to the LOVA type M43 formulations. The CL-20 samples A, D and G have much faster burn rates, the improvement being about 2.7 times at 10,000 psi and 4.3 times at 25,000 psi. The TNAZ filled samples B and C have intermediate burning rates and sample G is the fastest. Based upon this data, a combination of a first

propellant having burning rate ratio at least three times faster than a second combined propellant is now possible.

TABLE VI

Sample	10 kpsi (inch/sec)	15 kpsi (inch/sec)	25 kpsi (inch/sec)	Exponent	Friction (10^{-3})
A	4.5	6.9	11.8	1.04	0.30
B	3.1	4.7	7.9	1.02	0.25
C	3.5	5.1	8.4	0.97	0.46
D	4.5	6.8	11.2	0.98	0.54
E	1.7	2.6	4.4	1.03	0.14
F	1.7	2.7	4.5	1.04	0.12
G	4.6	9.0	21.0	1.65	0.001

To complete the evaluation of the samples, some mechanical behavior tests were performed, the results of which are below in Table VII. Tests were done on an Instron test machine at low strain.

TABLE VII

Sample	Stress (psi)	% elong (@max)	Modulus (psi)	Fail Modulus (psi)	Failure Mode
A	1780	36.7	7650	762	B
B	1260	26.2	8370	2480	B
C	412	22.8	3160	1280	B,P
D	641	30.4	3190	456	B,P
E	555	16.5	6220	2870	P,SC
F	1970	18.8	18,800	5760	P,S
G	1680	30.8	8860	2860	P

The symbols for the failure data in the last column of Table VII are as follows: B = barrel, P = pancake, SC = slight crumble, and S = split.

The data shows that high energy gun propellants at an energy level of 1300 J/g can be formulated with Oxetane binder in combination with high energy fillers. Desirable

burning rates with burn rate differential by a factor of 3 or more can be obtained from these formulations.

37 C.F.R. § 41.37(c)(vi) Grounds of Rejection to be Reviewed on Appeal

It is the position of Applicants that: (I) the Claims submitted by way of Preliminary Amendment on September 12, 2000, are fully supported by the Specification: those Claims do not, and never did, constitute New Matter; (II) the Art assembled by the Examiner does not predate the priority date of the present Application; and, (III) that Art, in any case, does not show or suggest the present invention.

37 C.F.R § 41.37(c)(viii) Argument

The present application was filed on September 12, 2000, as a Continuation of United States Patent Application Serial Number 09/351,530, filed on July 12, 1999. That case was a Continuation of United States Application Serial Number 09/038,490, filed March 6, 1998, and was in turn a Continuation of United States Patent Application Serial Number 08/744,042, filed November 6, 1996. That case was filed as a Continuation-in-Part of Provisional United States Patent Application Serial Number 60/006,671, filed November 13, 1995. A full copy of the parent application was provided and the only changes made were made by a contemporaneous Preliminary Amendment. That Amendment canceled Claims 1 to 5, and substituted new Claims 6 to 15.

In a departure from traditional patent practice, the Examiner held that the new claims, drafted in their entirety from the Specification as originally filed, constituted New

Matter, and required that the present Application and each of its parents be styled as Continuation-in-Part applications, and demanded that a new Continuation-in-Part Declaration be executed by all inventors. A period followed in which Applicants, in an attempt to advance prosecution, complied with the Examiner's demand.

The Examiner restricted the case to a single claim, and, in the FIRST ACTION on the merits, the Examiner has FINALLY rejected that Claim over Art which clearly does not pre-date the present Application.

It is the position of Applicants that: (I) the Claims submitted by way of Preliminary Amendment on September 12, 2000, are fully supported by the Specification, and those Claims do not, and never did, constitute New Matter; (II) The Art assembled by the Examiner does not predate the priority date of the present Application; and, (III) That Art, in any case, does not show or suggest the present invention.

(I) The Claims submitted by way of the Preliminary Amendment do not constitute New Matter.

Applicant's Attorney has previously stressed that the present claims were drafted from the original Specification and no other source, and it is difficult to see that there could be a question of support. Moreover, the subject matter of the claims track the claims originally filed with the Application and have been narrowed, to reflect the

preferred embodiment as illustrated by the Examples of the specification. This was further done in Amendments to the Claims filed later.

Thus, in the original Claim 1 of the Application, there was claimed:

"A propellant mixture formed by combining a pair of high energy propellants, said pair having a first fast burn rate high energy propellant and a second slow burn rate high energy propellant, the ratio of the fast burn rate to the slow burn rate being at least three as measured at 25 kpsi, the pair of propellants being equi-energetic and having an average impetus of at least 1300 Joules/g, the first propellant having 20% by wt. of an oxetane, thermoplastic elastomer energetic binder, 76% by wt. Cl-20 and 4% by wt. TNAZ, the second propellant including an oxetane thermoplastic elastomer energetic binder and RDX, whereby the second slow burn rate propellant enters the ballistic cycle later than the first fast burn rate propellant."

This same concept is reflected clearly in the Abstract, which states:

"...In a preferred embodiment, the propellant is actually a pair of high energy propellants comprising a mixture of first and second high energy propellants with the first propellant having a burning rate at least two times faster than the burning rate of the second propellant. The first propellant includes an oxetane thermoplastic elastomer energetic binder admixed with CL-20 high energy

explosive filler. The second propellant including an oxetane thermoplastic elastomer energetic binder admixed with RDX high energy explosive filler."

The Specification also recites, at Page 5, lines 8 to 15:

"It has also been discovered that a pair of high energy propellants may be combined to produce a propellant mixture having a first propellant having a burning rate at least three times faster than the burning rate of the second propellant. In the preferred embodiment, the first propellant includes an oxetane thermoplastic elastomer energetic binder admixed with CL-20 high energy explosive filler. The second propellant including an oxetane thermoplastic elastomer energetic binder admixed with RDX high energy explosive filler or RDX and TNAZ mixtures."

It should, thus, be clear that the Specification as filed supports a two propellant mixture, with a fast burn propellant containing an oxetane binder and CL-20 and a slower burn propellant containing an oxetane binder and RDX. This is what is shown in the present claim. The present claim contains further limitations, including an enumeration of the oxetane compounds which may be employed, as shown at page 4, lines 17 to 19, of the Specification, which states:

"It is made from two types of monomers: 3,3-bis-azidomethyl-oxetane, or BAMO as a hard block, and 3-azidomethyl-3-methyloxetane, or AMMO as a soft block."

The present claim also includes details of the mixture procedures, as described in the Specification at page 6, line37, to page 7, line 2, which states:

"The method of preparing the formulations comprised the steps of mixing at about 93°C and extruding at slightly lower temperatures."

These "slightly lower temperatures" shown in TABLE III to range from 55° C to 91° C as shown in the Die temperatures employed in processing the sample materials.

Thus, it is submitted that the present claim is fully supported by the Specification, and that all elements, including limitations are found there. The Examiner was expressly solicited to examine the claim as it is currently amended.

The Examiner asserts that such a mixture would be expected to have an average of the properties of the mixture, and cites several cases. Applicant's Attorney is informed that the impulse provided by a propellant is the area under a pressure-time trace. With a fast burning propellant, the pressure-time trace is a high spike; with a slow burning propellant, a lower, longer trace. By combining the two, the pressure-time trace starts out with a high spike, but tapers down to the lower, longer trace of the slower burning propellant, rather than zero. Thus, the impulse provided by the combination, the area under the curve of the pressure-time trace for the combination, is far greater for the

combination than it would be for an equivalent amount of either the fast burning propellant or the slower burning propellant taken individually.

This is accomplished, in the process of the appealed claim, by preparing each of the fast-burn and slow-burn components separately, admixing them and extruding the mixture.

It is submitted, therefore, that the amendments to the claims never constituted new matter, and that any rejection of those claims which relies upon a finding of new matter is in error and should be reversed.

(II) The Art assembled by the Examiner does not predate the priority date of the present Application.

It is submitted that there is no New Matter in the Present Application. As such, all of the Subject Matter is entitled to the earliest priority date upon which it was disclosed in a filed Application. This could be as early as November 13, 1995, the filing date of the Provisional Application from which the present application claims priority, but is unquestionably at least as early as November 6, 1996, the filing date of the first Utility Application.

None of the Art cited by the Examiner has a priority date that early. They could only be applied if New Matter was found, and even then, only against such New Matter. As such, the rejection of Claim 13 is submitted to be error and should be reversed.

(III) The Art does not show or suggest the present invention.

The Primary reference, United States Patent 5,690,868, to Strauss, Manning, Prezelski and Moy is entitled Multi-Layer High Energy Propellants. This reference discloses shows propellants and the method of making them, in which a fast burning formulation and a slow burning formulation (with a burn ratio of at least 2 to 1) are combined in layers. While this reference recognizes the advantage of a two-part formulation, it is obtained by layering separate and distinct layers of disparate formulations, not mixing them.

United States Patent Application 5,798,481 to Manning, Strauss, Prezelski and Moy is entitled High Energy TNAZ, Nitrocellulose Gun Propellant. This reference does show many of the compounds which are used in the present invention, but shows only a single propellant. There is no suggestion of a combination of a propellant with a fast burn rate and a propellant with a slow burn rate.

United States Patent 5,716,557 to Strauss, Manning, Prezelski and Moy is entitled Method of Making High Energy Explosives and Propellants. This reference shows high energy formulations which are prepared by melting the explosive to dissolve or plasticize

a binder, then extruding or casting the solution. The process, above the melting temperature of the explosive, is clearly different from that of the present Claim, which is carried out below the melting temperature of the explosive.

United States Patent 5,759,458 to Haaland, Braithwaite, Hartwell, Lott and Rose is entitled Process For The Manufacture of High Performance Gun Propellants. This reference shows the manufacture of propellants by coating high-energy oxidizer particles in the form of a molding powder with an energetic thermoplastic elastomeric binder, which is then extruded into the desired configuration. There is no mention of the combination of formulations having faster and slower burning rates.

Finally, United States Patent 6,171,530 to Haaland, Braithwaite, Hartwell, Lott and Rose is entitled Process For The Manufacture Of High Performance Gun Propellants. Like the previous reference, this reference shows the manufacture of propellants by coating high-energy oxidizer particles in the form of a molding powder with an energetic thermoplastic elastomeric binder, which is then extruded into the desired configuration. There is no mention of the combination of formulations having faster and slower burning rates.

Thus, it is submitted that, even if these references could be applied to the subject matter of the present claim, they do not show or suggest the subject matter of the appealed claim. Any rejection of the present claim over these references should be reversed.

37 C.F.R. § 41.37(c)(viii) Claims Appendix

Claim 13. A process for the preparation of a propellant composition material, comprising the steps of:

a. preparing a first propellant composition by:

heating an energetic oxetane thermoplastic elastomeric binder comprising from about five percent to about thirty percent by weight, based on the total weight of said first propellant, and chosen from the group consisting of 3,3-bis-azidomethyl-oxetane (BAMO) 3-azidomethyl-3-methyloxetane (AMMO), and combinations thereof, to a temperature of about ninety-five degrees Celsius (95° Celsius) or until said elastomeric binder melts, and

mixing into said elastomeric binder a high energy explosive filler comprising from about seventy percent to about ninety-five percent by weight, based on the weight of said first propellant, and consisting of cyclotrimethylene trinitramine (RDX), to form a first propellant composition having an impetus of at least about thirteen hundred joules per gram (1300 J/g) and a relatively slow burn rate measured at 25 kpsi;

cooling said first propellant composition to a temperature of from about fifty-five degrees Celsius (55° Celsius) to about ninety-one degrees Celsius (91° Celsius) to solidify said first propellant composition;

b. preparing a second propellant composition by:

heating an energetic oxetane thermoplastic elastomeric binder comprising from about five percent to about thirty percent by weight, based on the total weight of said second propellant, and chosen from the group consisting of 3,3-bis-azidomethyl-oxetane (BAMO), 3-azidomethyl-3-methyloxetane (AMMO), and combinations thereof, to a temperature of about ninety-five degrees Celsius (95° Celsius) or until said elastomeric binder melts, and

mixing into said elastomeric binder a high energy explosive filler comprising from about seventy percent to about ninety-five percent by weight, based on the weight of said second propellant, and chosen from the group consisting of hexanitrohexaazaisowurtzitane (CL-20), and 1,3,3-trinitroazetidine (TNAZ), and combinations thereof,

to form a second propellant composition having an impetus of at least about thirteen hundred joules per gram (1300 J/g) and a second and relatively fast burn rate on the order of about three times faster than said first burn rate of said first propellant composition as measured at 25 kpsi;

cooling said second propellant composition to a temperature of from about fifty-five degrees Celsius (55° Celsius) to about ninety-one degrees Celsius (91° Celsius) to solidify said second propellant composition;

c. mixing said first propellant composition and said second propellant composition, and extruding the mixture in a desired form

37 C.F.R. § 41.37(c)(ix) Evidence Appendix

None.

37 C.F.R. § 41.37(c)(x) Related Proceeding Appendix

None.

Conclusion

Appealed claim 13 is submitted to be patentable. Reversal of the Examiner is therefore respectfully requested.

Respectfully submitted,

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APPELLANT'S BRIEF ON APPEAL

Commissioner for Patents,
PO Box 1450,
Alexandria, Virginia 22313-1450

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None

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(a) Summary

The only claim presented in this appeal relates to a process for preparation of a propellant composition material. That material comprises a combination of two high energy propellants, each comprising an oxetane thermoplastic elastomer energetic binder admixed with a high energy explosive filler. The oxetane thermoplastic elastomer energetic binder preferably comprises from about five percent to about thirty percent by weight and the high energy explosive filler comprises from about seventy percent to

about ninety-five percent by weight of the composition. The preferred propellant further includes an explosive plasticizer, preferably in an amount of from about four percent to about seven percent of the plasticizer by weight of the propellant. The preferred filler is selected from the group consisting of CL-20, TNAZ, RDX, and mixtures thereof. The preferred plasticizer is selected from the group consisting of TNAZ, BTTN, TMETN, TEGDN, BDNPA/F, methyl NANA, ethyl NENA, and mixtures thereof. In the appealed claim, the propellant is actually a pair of high energy propellants comprising a mixture of first and second high energy propellants with the first propellant having a burn rate at least two times faster than the burn rate of the second propellant. The first propellant includes an oxetane thermoplastic elastomer energetic binder admixed with CL-20 high energy explosive filler. The second propellant including an oxetane thermoplastic energetic binder admixed with RDX high energy explosive filler. Plasticizers and relative amounts for each of the first and second propellants are the same as for the single propellant. The propellants are prepared separately, admixed and extruded in a desired form.

Details of the process, and references to the specification, are set out at length in the Argument which follows.

(b) Background

As with the evolution of many technologies, new weapon systems require higher munitions performance. Current standard propellants do not have adequate energy to deliver the performance required for systems that are presently being developed. JA2,

which is a standard double base propellant used, for example, in the M829A1 and M829A2 tank rounds, has an impetus value of 1150 Joules/gram (or J/g). M43, which is used in the M900A1 cartridge, has an impetus of 1181 J/g. Both of these conventional propellants do not have the energy level to deliver the muzzle velocity required in future high energy tank systems, such as the M829E3. Theoretical calculations have shown that a propellant containing an energy above the 1300 J/g threshold is needed.

In addition to the energy content, it has been shown by theoretical calculations that the ballistic cycle can be optimized and work output can be maximized by using a combination of two equienergetic propellants whose burning rates are different by a factor of three or four. The slow burning propellant is designed to enter the cycle at a later time. Current standard propellants do not exhibit such wide variation in burning rates at a specified energy level. Standard tank gun propellants such as XM39, M43, M44, or JA2 have burning rate differentials that are, at best, less than two to one, and thus they are unsatisfactory for solving the problem of delivering much higher muzzle velocities

In addition to the inability to generate adequate energy levels, present day propellants produce volatile organic compounds and ancillary waste, especially in enhanced demil and recyclability.

Accordingly, one object of the present invention is to provide a pair of high energy propellants whose average impetus is at or above the 1300 J/g level.

Another object of this invention is to provide a pair of high energy propellants whose burning rate differential is three or greater.

An additional object of this invention is to provide new energetic materials and processes that eliminate or greatly reduce both volatile organic compound production and ancillary waste through demil and recyclability.

(c) The Invention

The present invention has many advantages over the prior art propellant formulations. In its simplest form, the invention comprises an oxetane thermoplastic elastomer energetic binder admixed with a high energy explosive filler. A plasticizer may be added in some applications.

The oxetane thermoplastic elastomer energetic binder is an essential part of the invention and is available from Thiokol Corporation. It is capable of being melted at elevated temperatures to allow the binder to be processable with other propellant ingredients without the use of solvents, and this is a major advantage. In addition, as will be shown below, the oxetane thermoplastic energetic binder has excellent mechanical properties that are superior to conventional propellants because of elastomeric characteristics, especially at cold temperatures such as -20° to -40° F. This binder also has good mechanical properties that are important for uniform ballistic perfprmance as well as having low vulnerability to shaped charge jet impact.

In order to verify the excellent properties of the oxetane thermoplastic elastomer energetic binder, thermal stability tests were performed. Results of these tests are shown in Table I below.

TABLE I

Sample	Self Heat, °C	Ignition, °C
OXETANE Only	166	229
OXETANE/TNAZ (1:1)	153	216
OXETANE/CL-20 (1:1)	181	206
OXETANE/RDX (1:1)	196	222

In order to demonstrate the effectiveness of the propellants of this invention, a number of gun propellant formulations were mixed and extruded. The method of preparing the formulations comprised the steps of mixing at about 95°C and extruding at slightly lower temperatures. Processing at these temperatures provided a safe operating margin of at least 50°C because the self heat temperatures of the filler ranges from about 175°C to 192°C, but the preferred plasticizer TNAZ melts around 100°C, so that as some of the TNAZ begins to melt during processing at 95°C, a more fluid mix results that is easier to process. Presented below in Table II are seven formulations that have been prepared. All values for the composition are given in percent by weight, based on the total weight.

TABLE II

Sample	Oxetane	Filler/amount	Impetus, J/g	Flame, °K
A	24	CL-20/76	1297	3412
B	24	TNAZ/76	1309	3321
C	20	TNAZ/76*	1335	3475
D	20	CL-20/76*	1324	3575
E	13.3	RDX/80**	1319	3395
F	18	RDX/76***	1306	1348
G	20	CL-20****	1348	3683

* Sample also included 4% BDNPA/F as plasticizer
** Sample also included 6.7% BDNPA/F as plasticizer
*** Sample also included 6% TNAZ as plasticizer
**** Sample also included 4% TNAZ as plasticizer

Each of the above batches was formulated into a propellant by mixing and then extruding at a lower temperature. Selection and control of the precise extrusion parameters was important to obtain proper grain dimensions without excessive swelling of deformation. Table III below identifies the barrel temperature, die temperature and ram speed for each sample batch.

TABLE III

Sample	Barrel temp.,°C	Die temp.,°C	Ram speed, in/min.
A	82	70	0.14
B	95	86	0.14
C	89	82	0.06
D	87	78	0.03
E	100	91	0.14
F	100	85	0.08
G	66	55	0.04

Each of these formulations were tested for various properties to demonstrate the efficacy of the present invention: specifically, impact, differential thermal analysis

(DTA), and electrostatic and friction sensitivity characteristics. Presented below in Table IV are the results of these tests. The results show that impact sensitivities are similar to the conventional propellant M43, and that the products of this invention are quite thermally stable. A negative annotation for electrostatic sensitivity indicates no reaction to a 12 Joule electrostatic charge while a negative friction value is for a test with a 60 pound weight. The last two samples were not fully tested and n/a indicates that no data is available.

TABLE V

Sample	Impact (cm)	DTE, Self heat (°C)	DTA, Ignition (°C)	Electrostatic (12 Joules)	Friction (Bole)
A	50	179	203	neg	neg
B	40	175	211	neg	neg
C	20	175	212	neg	neg
D	40	174	206	neg	neg
E	40	206	225	neg	neg
F	n/a	n/a	n/a	neg	neg
G	n/a	n/a	n/a	neg	neg

The next evaluation of these samples was to determine the burn rate at various conditions. The data for the burn rates, presented below in Table VI, represent closed bomb data. As can be seen, RDX containing samples E and F have the slowest burning rates, which is comparable to the LOVA type M43 formulations. The CL-20 samples A, D and G have much faster burn rates, the improvement being about 2.7 times at 10,000 psi and 4.8 times at 25,000 psi. The TNAZ filled samples B and C have intermediate burning rates and sample G is the fastest. Based upon this data, a combination of a first

propellant having burning rate ratio at least three times faster than a second combined propellant is now possible.

TABLE VI

Sample	10 kpsi (inch/sec)	15 kpsi (inch/sec)	25 kpsi (inch/sec)	Exponent	Friction (10^{-3})
A	4.5	6.9	11.8	1.04	0.30
B	3.1	4.7	7.9	1.02	0.25
C	3.5	5.1	8.4	0.97	0.46
D	4.5	6.8	11.2	0.98	0.54
E	1.7	2.6	4.4	1.03	0.14
F	1.7	2.7	4.5	1.04	0.12
G	4.6	9.0	21.0	1.65	0.001

To complete the evaluation of the samples, some mechanical behavior tests were performed, the results of which are below in Table VII. Tests were done on an Instron test machine at low strain.

TABLE VII

Sample	Stress (psi)	% elong (@max)	Modulus (psi)	Fail Modulus (psi)	Failure Mode
A	1780	36.7	7650	762	B
B	1260	26.2	8370	2480	B
C	412	22.8	3160	1280	B,P
D	641	30.4	3190	456	B,P
E	555	16.5	6220	2870	P,SC
F	1970	18.8	18,800	5760	P,S
G	1680	30.8	8860	2860	P

The symbols for the failure data in the last column of Table VII are as follows: B = barrel, P = pancake, SC = slight crumble, and S = split.

The data shows that high energy gun propellants at an energy level of 1300 J/g can be formulated with Oxetane binder in combination with high energy fillers. Desirable

burning rates with burn rate differential by a factor of 3 or more can be obtained from these formulations.

37 C.F.R. § 41.37(c)(vi) Grounds of Rejection to be Reviewed on Appeal

It is the position of Applicants that: (I) the Claims submitted by way of Preliminary Amendment on September 12, 2000, are fully supported by the Specification: those Claims do not, and never did, constitute New Matter; (II) the Art assembled by the Examiner does not predate the priority date of the present Application; and, (III) that Art, in any case, does not show or suggest the present invention.

37 C.F.R. § 41.37(c)(viii) Argument

The present application was filed on September 12, 2000, as a Continuation of United States Patent Application Serial Number 09/351,530, filed on July 12, 1999. That case was a Continuation of United States Application Serial Number 09/038,490, filed March 6, 1998, and was in turn a Continuation of United States Patent Application Serial Number 08/744,042, filed November 6, 1996. That case was filed as a Continuation-in-Part of Provisional United States Patent Application Serial Number 60/006,671, filed November 13, 1995. A full copy of the parent application was provided and the only changes made were made by a contemporaneous Preliminary Amendment. That Amendment canceled Claims 1 to 5, and substituted new Claims 6 to 15.

In a departure from traditional patent practice, the Examiner held that the new claims, drafted in their entirety from the Specification as originally filed, constituted New

Matter, and required that the present Application and each of its parents be styled as Continuation-in-Part applications, and demanded that a new Continuation-in-Part Declaration be executed by all inventors. A period followed in which Applicants, in an attempt to advance prosecution, complied with the Examiner's demand.

The Examiner restricted the case to a single claim, and, in the FIRST ACTION on the merits, the Examiner has FINALLY rejected that Claim over Art which clearly does not pre-date the present Application.

It is the position of Applicants that: (I) the Claims submitted by way of Preliminary Amendment on September 12, 2000, are fully supported by the Specification, and those Claims do not, and never did, constitute New Matter; (II) The Art assembled by the Examiner does not predate the priority date of the present Application; and, (III) That Art, in any case, does not show or suggest the present invention.

(I) The Claims submitted by way of the Preliminary Amendment do not constitute New Matter.

Applicant's Attorney has previously stressed that the present claims were drafted from the original Specification and no other source, and it is difficult to see that there could be a question of support. Moreover, the subject matter of the claims track the claims originally filed with the Application and have been narrowed, to reflect the

preferred embodiment as illustrated by the Examples of the specification. This was further done in Amendments to the Claims filed later.

Thus, in the original Claim 1 of the Application, there was claimed:

"A propellant mixture formed by combining a pair of high energy propellants, said pair having a first fast burn rate high energy propellant and a second slow burn rate high energy propellant, the ratio of the fast burn rate to the slow burn rate being at least three as measured at 25 kpsi, the pair of propellants being equi-energetic and having an average impetus of at least 1300 Joules/g, the first propellant having 20% by wt. of an oxetane, thermoplastic elastomer energetic binder, 76% by wt. Cl-20 and 4% by wt. TNAZ, the second propellant including an oxetane thermoplastic elastomer energetic binder and RDX, whereby the second slow burn rate propellant enters the ballistic cycle later than the first fast burn rate propellant."

This same concept is reflected clearly in the Abstract, which states:

"...In a preferred embodiment, the propellant is actually a pair of high energy propellants comprising a mixture of first and second high energy propellants with the first propellant having a burning rate at least two times faster than the burning rate of the second propellant. The first propellant includes an oxetane thermoplastic elastomer energetic binder admixed with CL-20 high energy

explosive filler. The second propellant including an oxetane thermoplastic elastomer energetic binder admixed with RDX high energy explosive filler."

The Specification also recites, at Page 5, lines 8 to 15:

"It has also been discovered that a pair of high energy propellants may be combined to produce a propellant mixture having a first propellant having a burning rate at least three times faster than the burning rate of the second propellant. In the preferred embodiment, the first propellant includes an oxetane thermoplastic elastomer energetic binder admixed with CL-20 high energy explosive filler. The second propellant including an oxetane thermoplastic elastomer energetic binder admixed with RDX high energy explosive filler or RDX and TNAZ mixtures."

It should, thus, be clear that the Specification as filed supports a two propellant mixture, with a fast burn propellant containing an oxetane binder and CL-20 and a slower burn propellant containing an oxetane binder and RDX. This is what is shown in the present claim. The present claim contains further limitations, including an enumeration of the oxetane compounds which may be employed, as shown at page 4, lines 17 to 19, of the Specification, which states:

"It is made from two types of monomers: 3,3-bis-azidomethyl-oxetane, or BAMO as a hard block, and 3-azidomethyl-3-methyloxetane, or AMMO as a soft block."

The present claim also includes details of the mixture procedures, as described in the Specification at page 6, line37, to page 7, line 2, which states:

"The method of preparing the formulations comprised the steps of mixing at about 95°C and extruding at slightly lower temperatures."

These "slightly lower temperatures" shown in TABLE III to range from 55° C to 91° C as shown in the Die temperatures employed in processing the sample materials.

Thus, it is submitted that the present claim is fully supported by the Specification, and that all elements, including limitations are found there. The Examiner was expressly solicited to examine the claim as it is currently amended.

The Examiner asserts that such a mixture would be expected to have an average of the properties of the mixture, and cites several cases. Applicant's Attorney is informed that the impulse provided by a propellant is the area under a pressure-time trace. With a fast burning propellant, the pressure-time trace is a high spike; with a slow burning propellant, a lower, longer trace. By combining the two, the pressure-time trace starts out with a high spike, but tapers down to the lower, longer trace of the slower burning propellant, rather than zero. Thus, the impulse provided by the combination, the area under the curve of the pressure-time trace for the combination, is far greater for the

combination than it would be for an equivalent amount of either the fast burning propellant or the slower burning propellant taken individually.

This is accomplished, in the process of the appealed claim, by preparing each of the fast-burn and slow-burn components separately, admixing them and extruding the mixture.

It is submitted, therefore, that the amendments to the claims never constituted new matter, and that any rejection of those claims which relies upon a finding of new matter is in error and should be reversed.

(II) The Art assembled by the Examiner does not predate the priority date of the present Application.

It is submitted that there is no New Matter in the Present Application. As such, all of the Subject Matter is entitled to the earliest priority date upon which it was disclosed in a filed Application. This could be as early as November 13, 1995, the filing date of the Provisional Application from which the present application claims priority, but is unquestionably at least as early as November 6, 1996, the filing date of the first Utility Application.

None of the Art cited by the Examiner has a priority date that early. They could only be applied if New Matter was found, and even then, only against such New Matter. As such, the rejection of Claim 13 is submitted to be error and should be reversed.

(III) The Art does not show or suggest the present invention.

The Primary reference, United States Patent 5,690,868, to Strauss, Manning, Prezelski and Moy is entitled Multi-Layer High Energy Propellants. This reference discloses shows propellants and the method of making them, in which a fast burning formulation and a slow burning formulation (with a burn ratio of at least 2 to 1) are combined in layers. While this reference recognizes the advantage of a two-part formulation, it is obtained by layering separate and distinct layers of disparate formulations, not mixing them.

United States Patent Application 5,798,481 to Manning, Strauss, Prezelski and Moy is entitled High Energy TNAZ, Nitrocellulose Gun Propellant. This reference does show many of the compounds which are used in the present invention, but shows only a single propellant. There is no suggestion of a combination of a propellant with a fast burn rate and a propellant with a slow burn rate.

United States Patent 5,716,557 to Strauss, Manning, Prezelski and Moy is entitled Method of Making High Energy Explosives and Propellants. This reference shows high energy formulations which are prepared by melting the explosive to dissolve or plasticize

a binder, then extruding or casting the solution. The process, above the melting temperature of the explosive, is clearly different from that of the present Claim, which is carried out below the melting temperature of the explosive.

United States Patent 5,759,458 to Haaland, Braithwaite, Hartwell, Lott and Rose is entitled Process For The Manufacture of High Performance Gun Propellants. This reference shows the manufacture of propellants by coating high-energy oxidizer particles in the form of a molding powder with an energetic thermoplastic elastomeric binder, which is then extruded into the desired configuration. There is no mention of the combination of formulations having faster and slower burning rates.

Finally, United States Patent 6,171,530 to Haaland, Braithwaite, Hartwell, Lott and Rose is entitled Process For The Manufacture Of High Performance Gun Propellants. Like the previous reference, this reference shows the manufacture of propellants by coating high-energy oxidizer particles in the form of a molding powder with an energetic thermoplastic elastomeric binder, which is then extruded into the desired configuration. There is no mention of the combination of formulations having faster and slower burning rates.

Thus, it is submitted that, even if these references could be applied to the subject matter of the present claim, they do not show or suggest the subject matter of the appealed claim. Any rejection of the present claim over these references should be reversed.

37 C.F.R. § 41.37(c)(viii) **Claims Appendix**

Claim 13. A process for the preparation of a propellant composition material, comprising the steps of:

a. preparing a first propellant composition by:

heating an energetic oxetane thermoplastic elastomeric binder comprising from about five percent to about thirty percent by weight, based on the total weight of said first propellant, and chosen from the group consisting of 3,3-bis-azidomethyl-oxetane (BAMO), 3-azidomethyl-3-methyloxetane (AMMO), and combinations thereof, to a temperature of about ninety-five degrees Celsius (95° Celsius) or until said elastomeric binder melts, and

mixing into said elastomeric binder a high energy explosive filler comprising from about seventy percent to about ninety-five percent by weight, based on the weight of said first propellant, and consisting of cyclotrimethylene trinitramine (RDX), to form a first propellant composition having an impetus of at least about thirteen hundred joules per gram (1300 J/g) and a relatively slow burn rate measured at 25 kpsi;

cooling said first propellant composition to a temperature of from about fifty-five degrees Celsius (55° Celsius) to about ninety-one degrees Celsius (91° Celsius) to solidify said first propellant composition;

b. preparing a second propellant composition by:

heating an energetic oxetane thermoplastic elastomeric binder comprising from about five percent to about thirty percent by weight, based on the total weight of said second propellant, and chosen from the group consisting of 3,3-bis-azidomethyl-oxetane (BAMO) 3-azidomethyl-3-methyloxetane (AMMO), and combinations thereof, to a temperature of about ninety-five degrees Celsius (95° Celsius) or until said elastomeric binder melts, and

mixing into said elastomeric binder a high energy explosive filler comprising from about seventy percent to about ninety-five percent by weight, based on the weight of said second propellant, and chosen from the group consisting of hexanitrohexaazaisowurtzitane (CL-20), and 1,3,3-trinitroazetidine (TNAZ), and combinations thereof,

to form a second propellant composition having an impetus of at least about thirteen hundred joules per gram (1300 J/g) and a second and relatively fast burn rate on the order of about three times faster than said first burn rate of said first propellant composition as measured at 25 kpsi;

cooling said second propellant composition to a temperature of from about fifty-five degrees Celsius (55° Celsius) to about ninety-one degrees Celsius (91° Celsius) to solidify said second propellant composition;

c. mixing said first propellant composition and said second propellant composition, and extruding the mixture in a desired form

37 C.F.R. § 41.37(c)(ix) Evidence Appendix

None.

37 C.F.R § 41.37(c)(x) Related Proceeding Appendix

None.

Conclusion

Appealed claim 13 is submitted to be patentable. Reversal of the Examiner is therefore respectfully requested.

Respectfully submitted,

Robert Charles Beam

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Date: February 9, 2005

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Docket No. 95-18A2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

ON APPEAL TO THE BOARD OF APPEALS

In re: Application of:

Thelma G. Manning,
Joseph L. Prezelski,
Sam Moy,
Bernard Strauss,
James Hartwell,
Arpad A. Juhasz,
and
Robert J. Lieb

Serial No.: 09/665,190

Filed: September 12, 2000

Examiner: Edward A. Miller

Group Art Unit: 3641

For: HIGH ENERGY THERMOPLASTIC ELASTOMER PROPELLANT

APPELLANT'S BRIEF ON APPEAL

Commissioner for Patents,
PO Box 1450,
Alexandria, Virginia 22313-1450

Dear Sir:

This paper is submitted in compliance with 37 C.F.R. § 41.37, and is a Brief on behalf of the Appellant in the above-captioned appeal from the final rejection of claims . No claims have been allowed in the present application.

ORAL HEARING

An oral hearing on the issues in this appeal is requested.

TABLE OF CONTENTS

37 C.F.R. § 41.37(c) Page No.

37 C.F.R. § 41.37(c)(i) Real Party In Interest

The real party in interest in this Application is the United States of America. The present application is assigned of record to the United States of America, as represented by the Secretary of the Army.

37 C.F.R. § 41.37(c)(ii) Related Appeals and Interferences

None

37 C.F.R. § 41.37(c)(iii) **Status of Claims**

The claims are 6 to 15. Claims 6 to 12, 14, and 15 stand withdrawn from consideration pursuant to a Restriction Requirement traversed by Applicants. Claim 13 stands FINALLY rejected. Although both 35 U.S.C. § 102 and 35 U.S.C. § 103(a) are quoted in the most recent Office Action, the Claim appears to be rejected only under 35 U.S.C. § 103(a) as being unpatentable over United States Patent 5,690,868 to Strauss, Manning, Prezelski, and Moy, in view of United States Patent 5,798,481 to Manning, Strauss, Prezelski, and Moy, United States Patent 5,716,557 to Strauss, Manning, Prezelski, and Moy, United States Patent 5,759,458 to Haaland, Braithwaite, Hartwell, Lott, and Rose, and United States Patent 6,171,530 to Haaland, Braithwaite, Hartwell, Lott, and Rose.

37 C.F.R. § 41.37(c)(iv) Status of Amendments

There are no unentered amendments.

37 C.F.R. § 41.37(c)(v) Summary of the Claimed Invention

(a) Summary

The only claim presented in this appeal relates to a process for preparation of a propellant composition material. That material comprises a combination of two high energy propellants, each comprising an oxetane thermoplastic elastomer energetic binder admixed with a high energy explosive filler. The oxetane thermoplastic elastomer energetic binder preferably comprises from about five percent to about thirty percent by weight and the high energy explosive filler comprises from about seventy percent to

about ninety-five percent by weight of the composition. The preferred propellant further includes an explosive plasticizer, preferably in an amount of from about four percent to about seven percent of the plasticizer by weight of the propellant. The preferred filler is selected from the group consisting of CL-20, TNAZ, RDX, and mixtures thereof. The preferred plasticizer is selected from the group consisting of TNAZ, BTTN, TMETN, TEGDN, BDNPA/F, methyl NANA, ethyl NENA, and mixtures thereof. In the appealed claim, the propellant is actually a pair of high energy propellants comprising a mixture of first and second high energy propellants with the first propellant having a burn rate at least two times faster than the burn rate of the second propellant. The first propellant includes an oxetane thermoplastic elastomer energetic binder admixed with CL-20 high energy explosive filler. The second propellant including an oxetane thermoplastic energetic binder admixed with RDX high energy explosive filler. Plasticizers and relative amounts for each of the first and second propellants are the same as for the single propellant. The propellants are prepared separately, admixed and extruded in a desired form.

Details of the process, and references to the specification, are set out at length in the Argument which follows.

(b) Background

As with the evolution of many technologies, new weapon systems require higher munitions performance. Current standard propellants do not have adequate energy to deliver the performance required for systems that are presently being developed. JA2,

which is a standard double base propellant used, for example, in the M829A1 and M829A2 tank rounds, has an impetus value of 1150 Joules/gram (or J/g). M43, which is used in the M900A1 cartridge, has an impetus of 1181 J/g. Both of these conventional propellants do not have the energy level to deliver the muzzle velocity required in future high energy tank systems, such as the M829E3. Theoretical calculations have shown that a propellant containing an energy above the 1300 J/g threshold is needed.

In addition to the energy content, it has been shown by theoretical calculations that the ballistic cycle can be optimized and work output can be maximized by using a combination of two equienergetic propellants whose burning rates are different by a factor of three or four. The slow burning propellant is designed to enter the cycle at a later time Current standard propellants do not exhibit such wide variation in burning rates at a specified energy level. Standard tank gun propellants such as XM39, M43, M44, or JA2 have burning rate differentials that are, at best, less than two to one, and thus they are unsatisfactory for solving the problem of delivering much higher muzzle velocities

In addition to the inability to generate adequate energy levels, present day propellants produce volatile organic compounds and ancillary waste, especially in enhanced demil and recyclability.

Accordingly, one object of the present invention is to provide a pair of high energy propellants whose average impetus is at or above the 1300 J/g level.

Another object of this invention is to provide a pair of high energy propellants whose burning rate differential is three or greater.

An additional object of this invention is to provide new energetic materials and processes that eliminate or greatly reduce both volatile organic compound production and ancillary waste through demil and recyclability.

(c) The Invention

The present invention has many advantages over the prior art propellant formulations. In its simplest form, the invention comprises an oxetane thermoplastic elastomer energetic binder admixed with a high energy explosive filler. A plasticizer may be added in some applications.

The oxetane thermoplastic elastomer energetic binder is an essential part of the invention, and is available from Thiokol Corporation. It is capable of being melted at elevated temperatures to allow the binder to be processable with other propellant ingredients without the use of solvents, and this is a major advantage. In addition, as will be shown below, the oxetane thermoplastic energetic binder has excellent mechanical properties that are superior to conventional propellants because of elastomeric characteristics, especially at cold temperatures such as -20° to -40° F. This binder also has good mechanical properties that are important for uniform ballistic perfprmance as well as having low vulnerability to shaped charge jet impact.

In order to verify the excellent properties of the oxetane thermoplastic elastomer energetic binder, thermal stability tests were performed. Results of these tests are shown in Table I below.

TABLE I

Sample	Self Heat, °C	Ignition, °C
OXETANE Only	166	229
OXETANE/TNAZ (1:1)	153	216
OXETANE/CL-20 (1:1)	181	206
OXETANE/RDX (1:1)	196	222

In order to demonstrate the effectiveness of the propellants of this invention, a number of gun propellant formulations were mixed and extruded. The method of preparing the formulations comprised the steps of mixing at about 95°C and extruding at slightly lower temperatures. Processing at these temperatures provided a safe operating margin of at least 50°C because the self heat temperatures of the filler ranges from about 175°C to 192°C, but the preferred plasticizer TNAZ melts around 100°C, so that as some of the TNAZ begins to melt during processing at 95°C, a more fluid mix results that is easier to process. Presented below in Table II are seven formulations that have been prepared. All values for the composition are given in percent by weight, based on the total weight.

TABLE II

Sample	Oxctane	Filler/amount	Impetus, J/g	Flame, °K
A	24	CL-20/76	1297	3412
B	24	TNAZ/76	1309	3321
C	20	TNAZ/76*	1335	3475
D	20	CL-20/76*	1324	3575
E	13.3	RDX/80**	1319	3395
F	18	RDX/76***	1306	1348
G	20	CL-20****	1348	3683

* Sample also included 4% BDNPA/F as plasticizer
** Sample also included 6.7% BDNPA/F as plasticizer
*** Sample also included 6% TNAZ as plasticizer
**** Sample also included 4% TNAZ as plasticizer

Each of the above batches was formulated into a propellant by mixing and then extruding at a lower temperature. Selection and control of the precise extrusion parameters was important to obtain proper grain dimensions without excessive swelling of deformation. Table III below identifies the barrel temperature, die temperature and ram speed for each sample batch.

TABLE III

Sample	Barrel temp.,°C	Die temp.,°C	Ram speed, in/min.
A	82	70	0.14
B	95	86	0.14
C	89	82	0.06
D	87	78	0.03
E	100	91	0.14
F	100	85	0.08
G	66	55	0.04

Each of these formulations were tested for various properties to demonstrate the efficacy of the present invention: specifically, impact, differential thermal analysis

(DTA), and electrostatic and friction sensitivity characteristics. Presented below in Table IV are the results of these tests. The results show that impact sensitivities are similar to the conventional propellant M43, and that the products of this invention are quite thermally stable. A negative annotation for electrostatic sensitivity indicates no reaction to a 12 Joule electrostatic charge while a negative friction value is for a test with a 60 pound weight. The last two samples were not fully tested and n/a indicates that no data is available.

TABLE V

Sample	Impact (cm)	DTE, Self heat (°C)	DTA, Ignition (°C)	Electrostatic (12 Joules)	Friction (Bole)
A	50	179	203	neg	neg
B	40	175	211	neg	neg
C	20	175	212	neg	neg
D	40	174	206	neg	neg
E	40	206	225	neg	neg
F	n/a	n/a	n/a	neg	neg
G	n/a	n/a	n/a	neg	neg

The next evaluation of these samples was to determine the burn rate at various conditions. The data for the burn rates, presented below in Table VI, represent closed bomb data. As can be seen, RDX containing samples E and F have the slowest burning rates, which is comparable to the LOVA type M43 formulations. The CL-20 samples A, D and G have much faster burn rates, the improvement being about 2.7 times at 10,000 psi and 4.3 times at 25,000 psi. The TNAZ filled samples B and C have intermediate burning rates and sample G is the fastest. Based upon this data, a combination of a first

propellant having burning rate ratio at least three times faster than a second combined propellant is now possible.

TABLE VI

Sample	10 kpsi (inch/sec)	15 kpsi (inch/sec)	25 kpsi (inch/sec)	Exponent	Friction (10^{-3})
A	4.5	6.9	11.8	1.04	0.30
B	3.1	4.7	7.9	1.02	0.25
C	3.5	5.1	8.4	0.97	0.46
D	4.5	6.8	11.2	0.98	0.54
E	1.7	2.6	4.4	1.03	0.14
F	1.7	2.7	4.5	1.04	0.12
G	4.6	9.0	21.0	1.65	0.001

To complete the evaluation of the samples, some mechanical behavior tests were performed, the results of which are below in Table VII. Tests were done on an Instron test machine at low strain.

TABLE VII

Sample	Stress (psi)	% elong (@max)	Modulus (psi)	Fail Modulus (psi)	Failure Mode
A	1780	36.7	7650	762	B
B	1260	26.2	8370	2480	B
C	412	22.8	3160	1280	B,P
D	641	30.4	3190	456	B,P
E	555	16.5	6220	2870	P,SC
F	1970	18.8	18,800	5760	P,S
G	1680	30.8	8860	2860	P

The symbols for the failure data in the last column of Table VII are as follows: B = barrel, P = pancake, SC = slight crumble, and S = split.

The data shows that high energy gun propellants at an energy level of 1300 J/g can be formulated with Oxetane binder in combination with high energy fillers. Desirable

burning rates with burn rate differential by a factor of 3 or more can be obtained from these formulations.

37 C.F.R. § 41.37(c)(vi) Grounds of Rejection to be Reviewed on Appeal

It is the position of Applicants that: (I) the Claims submitted by way of Preliminary Amendment on September 12, 2000, are fully supported by the Specification: those Claims do not, and never did, constitute New Matter; (II) the Art assembled by the Examiner does not predate the priority date of the present Application; and, (III) that Art, in any case, does not show or suggest the present invention.

37 C.F.R § 41.37(c)(viii) Argument

The present application was filed on September 12, 2000, as a Continuation of United States Patent Application Serial Number 09/351,530, filed on July 12, 1999. That case was a Continuation of United States Application Serial Number 09/038,490, filed March 6, 1998, and was in turn a Continuation of United States Patent Application Serial Number 08/744,042, filed November 6, 1996. That case was filed as a Continuation-in-Part of Provisional United States Patent Application Serial Number 60/006,671, filed November 13, 1995. A full copy of the parent application was provided and the only changes made were made by a contemporaneous Preliminary Amendment. That Amendment canceled Claims 1 to 5, and substituted new Claims 6 to 15.

In a departure from traditional patent practice, the Examiner held that the new claims, drafted in their entirety from the Specification as originally filed, constituted New

Matter, and required that the present Application and each of its parents be styled as Continuation-in-Part applications, and demanded that a new Continuation-in-Part Declaration be executed by all inventors. A period followed in which Applicants, in an attempt to advance prosecution, complied with the Examiner's demand.

The Examiner restricted the case to a single claim, and, in the FIRST ACTION on the merits, the Examiner has FINALLY rejected that Claim over Art which clearly does not pre-date the present Application.

It is the position of Applicants that: (I) the Claims submitted by way of Preliminary Amendment on September 12, 2000, are fully supported by the Specification, and those Claims do not, and never did, constitute New Matter; (II) The Art assembled by the Examiner does not predate the priority date of the present Application; and, (III) That Art, in any case, does not show or suggest the present invention.

(I) The Claims submitted by way of the Preliminary Amendment do not constitute New Matter.

Applicant's Attorney has previously stressed that the present claims were drafted from the original Specification and no other source, and it is difficult to see that there could be a question of support. Moreover, the subject matter of the claims track the claims originally filed with the Application and have been narrowed, to reflect the

preferred embodiment as illustrated by the Examples of the specification. This was further done in Amendments to the Claims filed later.

Thus, in the original Claim 1 of the Application, there was claimed:

"A propellant mixture formed by combining a pair of high energy propellants, said pair having a first fast burn rate high energy propellant and a second slow burn rate high energy propellant, the ratio of the fast burn rate to the slow burn rate being at least three as measured at 25 kpsi, the pair of propellants being equi-energetic and having an average impetus of at least 1300 Joules/g, the first propellant having 20% by wt. of an oxetane, thermoplastic elastomer energetic binder, 76% by wt. Cl-20 and 4% by wt. TNAZ, the second propellant including an oxetane thermoplastic elastomer energetic binder and RDX, whereby the second slow burn rate propellant enters the ballistic cycle later than the first fast burn rate propellant."

This same concept is reflected clearly in the Abstract, which states:

"...In a preferred embodiment, the propellant is actually a pair of high energy propellants comprising a mixture of first and second high energy propellants with the first propellant having a burning rate at least two times faster than the burning rate of the second propellant. The first propellant includes an oxetane thermoplastic elastomer energetic binder admixed with CL-20 high energy

explosive filler. The second propellant including an oxetane thermoplastic elastomer energetic binder admixed with RDX high energy explosive filler."

The Specification also recites, at Page 5, lines 8 to 15:

"It has also been discovered that a pair of high energy propellants may be combined to produce a propellant mixture having a first propellant having a burning rate at least three times faster than the burning rate of the second propellant. In the preferred embodiment, the first propellant includes an oxetane thermoplastic elastomer energetic binder admixed with CL-20 high energy explosive filler. The second propellant including an oxetane thermoplastic elastomer energetic binder admixed with RDX high energy explosive filler or RDX and TNAZ mixtures."

It should, thus, be clear that the Specification as filed supports a two propellant mixture, with a fast burn propellant containing an oxetane binder and CL-20 and a slower burn propellant containing an oxetane binder and RDX. This is what is shown in the present claim. The present claim contains further limitations, including an enumeration of the oxetane compounds which may be employed, as shown at page 4, lines 17 to 19, of the Specification, which states:

"It is made from two types of monomers: 3,3-bis-azidomethyl-oxetane, or BAMO as a hard block, and 3-azidomethyl-3-methyloxetane, or AMMO as a soft block."

The present claim also includes details of the mixture procedures, as described in the Specification at page 6, line37, to page 7, line 2, which states:

"The method of preparing the formulations comprised the steps of mixing at about 93°C and extruding at slightly lower temperatures."

These "slightly lower temperatures" shown in TABLE III to range from 55° C to 91° C as shown in the Die temperatures employed in processing the sample materials.

Thus, it is submitted that the present claim is fully supported by the Specification, and that all elements, including limitations are found there. The Examiner was expressly solicited to examine the claim as it is currently amended.

The Examiner asserts that such a mixture would be expected to have an average of the properties of the mixture, and cites several cases. Applicant's Attorney is informed that the impulse provided by a propellant is the area under a pressure-time trace. With a fast burning propellant, the pressure-time trace is a high spike; with a slow burning propellant, a lower, longer trace. By combining the two, the pressure-time trace starts out with a high spike, but tapers down to the lower, longer trace of the slower burning propellant rather than zero. Thus, the impulse provided by the combination, the area under the curve of the pressure-time trace for the combination, is far greater for the

combination than it would be for an equivalent amount of either the fast burning propellant or the slower burning propellant taken individually.

This is accomplished, in the process of the appealed claim, by preparing each of the fast-burn and slow-burn components separately, admixing them and extruding the mixture.

It is submitted, therefore, that the amendments to the claims never constituted new matter, and that any rejection of those claims which relies upon a finding of new matter is in error and should be reversed.

(II) The Art assembled by the Examiner does not predate the priority date of the present Application.

It is submitted that there is no New Matter in the Present Application. As such, all of the Subject Matter is entitled to the earliest priority date upon which it was disclosed in a filed Application. This could be as early as November 13, 1995, the filing date of the Provisional Application from which the present application claims priority, but is unquestionably at least as early as November 6, 1996, the filing date of the first Utility Application.

None of the Art cited by the Examiner has a priority date that early. They could only be applied if New Matter was found, and even then, only against such New Matter. As such, the rejection of Claim 13 is submitted to be error and should be reversed.

(II) The Art does not show or suggest the present invention.

The Primary reference, United States Patent 5,690,868, to Strauss, Manning, Prezelski and Moy is entitled Multi-Layer High Energy Propellants. This reference discloses shows propellants and the method of making them, in which a fast burning formulation and a slow burning formulation (with a burn ratio of at least 2 to 1) are combined in layers. While this reference recognizes the advantage of a two-part formulation, it is obtained by layering separate and distinct layers of disparate formulations, not mixing them.

United States Patent Application 5,798,481 to Manning, Strauss, Prezelski and Moy is entitled High Energy TNAZ, Nitrocellulose Gun Propellant. This reference does show many of the compounds which are used in the present invention, but shows only a single propellant. There is no suggestion of a combination of a propellant with a fast burn rate and a propellant with a slow burn rate.

United States Patent 5,716,557 to Strauss, Manning, Prezelski and Moy is entitled Method of Making High Energy Explosives and Propellants. This reference shows high energy formulations which are prepared by melting the explosive to dissolve or plasticize

a binder, then extruding or casting the solution. The process, above the melting temperature of the explosive, is clearly different from that of the present Claim, which is carried out below the melting temperature of the explosive.

United States Patent 5,759,458 to Haaland, Braithwaite, Hartwell, Lott and Rose is entitled Process For The Manufacture of High Performance Gun Propellants. This reference shows the manufacture of propellants by coating high-energy oxidizer particles in the form of a molding powder with an energetic thermoplastic elastomeric binder, which is then extruded into the desired configuration. There is no mention of the combination of formulations having faster and slower burning rates.

Finally, United States Patent 6,171,530 to Haaland, Braithwaite, Hartwell, Lott and Rose is entitled Process For The Manufacture Of High Performance Gun Propellants. Like the previous reference, this reference shows the manufacture of propellants by coating high-energy oxidizer particles in the form of a molding powder with an energetic thermoplastic elastomeric binder, which is then extruded into the desired configuration. There is no mention of the combination of formulations having faster and slower burning rates.

Thus, it is submitted that, even if these references could be applied to the subject matter of the present claim, they do not show or suggest the subject matter of the appealed claim. Any rejection of the present claim over these references should be reversed.

37 C.F.R. § 41.37(c)(viii) Claims Appendix

Claim 13 A process for the preparation of a propellant composition material, comprising the steps of:

a. preparing a first propellant composition by:

heating an energetic oxetane thermoplastic elastomeric binder comprising from about five percent to about thirty percent by weight, based on the total weight of said first propellant, and chosen from the group consisting of 3,3-bis-azidomethyl-oxetane (BAMO), 3-azidomethyl-3-methyloxetane (AMMO), and combinations thereof, to a temperature of about ninety-five degrees Celsius (95° Celsius) or until said elastomeric binder melts, and

mixing into said elastomeric binder a high energy explosive filler comprising from about seventy percent to about ninety-five percent by weight, based on the weight of said first propellant, and consisting of cyclotrimethylene trinitramine (RDX), to form a first propellant composition having an impetus of at least about thirteen hundred joules per gram (1300 J/g) and a relatively slow burn rate measured at 25 kpsi;

cooling said first propellant composition to a temperature of from about fifty-five degrees Celsius (55° Celsius) to about ninety-one degrees Celsius (91° Celsius) to solidify said first propellant composition;

b. preparing a second propellant composition by:

heating an energetic oxetane thermoplastic elastomeric binder comprising from about five percent to about thirty percent by weight, based on the total weight of said second propellant, and chosen from the group consisting of 3,3-bis-azidomethyl-oxetane (BAMO), 3-azidomethyl-3-methyloxetane (AMMO), and combinations thereof, to a temperature of about ninety-five degrees Celsius (95° Celsius) or until said elastomeric binder melts, and

mixing into said elastomeric binder a high energy explosive filler comprising from about seventy percent to about ninety-five percent by weight, based on the weight of said second propellant, and chosen from the group consisting of hexanitrohexaazaisowurtzitane (CL-20), <u>and</u> 1,3,3-trinitroazetidine (TNAZ), and combinations thereof,

to form a second propellant composition having an impetus of at least about thirteen hundred joules per gram (1300 J/g) and a second and relatively fast burn rate on the order of about three times faster than said first burn rate of said first propellant composition as measured at 25 kpsi;

cooling said second propellant composition to a temperature of from about fifty-five degrees Celsius (55° Celsius) to about ninety-one degrees Celsius (91° Celsius) to solidify said second propellant composition;

c. mixing said first propellant composition and said second propellant composition, and extruding the mixture in a desired form

37 C.F.R. § 41.37(c)(ix) Evidence Appendix

None.

37 C.F.R. § 41.37(c)(x) Related Proceeding Appendix

None.

Conclusion

Appealed claim 13 is submitted to be patentable. Reversal of the Examiner is therefore respectfully requested.

Respectfully submitted,

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